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ABSTRACT

Various examples of communication in species ranging from bumble bees to dolphins are examined in this paper. Focus is directed to indications of the cognitive ability of each species. The signals of cognition include evidence of: adaptability to a new situation; long term memory; and the property of displacement. Most of the sources reviewed represented collections of ethological studies. Cognitive components were found in the majority of species investigated. Further explorations in the area of canine cognitive abilities are recommended. (Author/ML)

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Animal Communication and Its Cognitive Indications

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Abstract

This paper examined various examples of communication in species ranging from bumble bees to dolphins. The focus was on its indication of the cognitive ability of each species. The signals of cognition include evidence of: adaptability of an individual to a new situation; long term memory and/or the property of displacement. Most of the sources reviewed represented collections of ethological studies. Cognitive components were found in the majority of species represented. Further research in the area of canine cognitive abilities is recommended.

Animal Communication and Its Cognitive Indications

The definition of communication has become more inclusive since J.P. Scott's 1968 concept of "any stimulus arising from one animal and eliciting a response in another" (cited in Sebeok, 1968, p.17). We have since acknowledged that communication does not necessarily effect any response. Therefore, the current definition, as cited by the Thesaurus of Psychological Index Terms, reads a "conceptually broad array term referring to the transmission of verbal or nonverbal information" (p. 40). Many ethologists draw a distinction between general communicative behavior and that which has a signaling function.

Early ethologists had categorized the messages and meanings common to the communication of most species as: (1) inhibiting; (2) anxiety over potential disruptive situations; (3) aggressiveness; (4) fear and (5) identification (Sebeok, 1968). A more current model of widespread behavioral messages has been presented by Smith (1977, pp.85-86). This includes: "interactional behavior, attack behavior, escape behavior, indecisive behavior, locomotory behavior, general sets of behavior patterns, behavior of remaining with site, seeking behavior, receptive behavior and attentive behavior." He further separated nonbehavioral messages into: (1)identifying messages (population class, physiological state and bonding

classes) and (2) location message.

Exemplifying what Smith called seeking behavior is the howling of a jackel expressing his yearning to interact. Soon, all the jackels within hearing distance are howling with him. This acts as a releaser of social interaction. Although, as humans, we rely predominantly on visual and auditory modes of communication, it is important to realize that the chemical and tactile modes also exist.

The issue of cognitive abilities in animals has been a highly controversial one. As with all aspects of psychology, there exist a number of theoretical viewpoints or approaches. Ethologists tend to describe behavior in terms of stimuli, responses and adaptive advantages. Materialists say that all organisms that experience thoughts have a central nervous system consisting of the same basic elements: nerve cells or neurons, synapses and modified neurons that synthesize and release neural transmitters. The behaviorists disregard subjective feelings and conscious thoughts in animals as they do in humans. The solipsist believes that no minds exist except his own. The view which regards all matter as having some mental attributes on a continuum across species is panpsychism. The cognitive view says that an animal is likely to think about what it is doing, at least on some occasions.

At this point, anyone who has had a dog can think of

many instances when it showed empathy for other pets and people. According to Bunge (cited in Griffin, 1984) empathy would qualify as cognition since he includes perceiving, feeling, remembering, imagining, willing and thinking to be mental states or processes. Another materialist named Armstrong (cited in Griffin, 1984) sees thoughts as dispositions to behave in certain ways plus the ability to think consciously about objects and events. Not only are these criteria diverse, but they are difficult to surmise or measure. The current concept of cognition as denoted by the Thesaurus of Psychological Index Terms is " the act or process of knowing which includes awareness and judgement, perceiving, reasoning and conceiving" (p.38).

Cognition, in terms of an animal's estimated conscious awareness, has a few characteristics. One crude measure of conscious conscious thinking are known as 'event related potentials' (ERP's). They seem to be associated with more complex brain activities and reflect brain waves. The limited experiments thus far have shown long-latency ERP's to occur in cats and monkeys under conditions roughly comparable to those with human subjects, but neurophysiologists find it to be a very course measure of brain activity.

The most accepted indicators of cognition in animals now include: long term memory; versatile adaptability and the

property of displacement. Versatile adaptability of behavior is exhibited when an animal behaves appropriately in a new situation displaying specific actions ordinarily not called for. Displacement is a property of human language extended to include other communication which refers to information being expressed about something displaced from the immediate situation. Cognition also can be revealed in the ability to learn and the quickness of learning.

Since communicative behavior appears to convey thoughts and feelings from one animal to another, it can teach us about their thought processes. Subsequently, I will present key communicative behaviors of various species for observation in view of cognitive qualities. Humans have been blinded by ~~their~~ defensive attitudes of cognitive supremacy, refusing to allow for the possibility of cognition in other species. In view of the current constructs, another look is warranted. As Edward C. Tolman articulated " behavior reeks of purpose and cognition" (cited in Griffin, 1984, p. 19).

In the bird kingdom, carrion crows have exhibited behavior which demonstrates that they learn of new objects to eat and mark their location. H. Croze (1970) (cited in Griffin, 1984) conducted an experiment in which he set out a row of empty mussel shells on a beach near where the crows usually gathered. Beside each shell he placed small pieces of beef.

They learned quickly that these mussel shells lying on the sand, that would normally be empty, had become new sources of food. Within hours they came and ate the meat. The next day, Croze laid out shells in a row but buried the meat under each. The crows returned to find empty shells and dug with their bills in the sand until they found the meat.

G. Orians (1980) studied the behavior of redwinged blackbirds and their close relatives, the yellowheaded blackbirds (cited in Griffin, 1984). During each breeding season, the male blackbird must select a territory out of large expanses of marshlands. In this choice, the abundance of insects for food is crutial and, in conjunction, the lack of carp who eat these aquatic insects before they can emerge and become prey for blackbirds. Amazingly, at the time of the choice of territory, the insects are still larval and not visible being under water, so the birds must make their choices on the basis of the properties of the marsh when they first arrive. The most noticeable being density of stalks of aquatic vegetation. Both these species of birds do end up choosing the grounds with the heaviest insect populations. Another interesting finding was that when blackbirds are not feeding the young, they will eat dragonflies, but if there are young to feed, they won't indulge, but they will bring the dragonflies to the nestling.

Recently, Benjamin Beck has conducted some astounding experiments observing shell dropping (cited in Griffin, 1984). Herring gulls will carry shellfish to rocky areas or pavements and drop them until the shells break and they can then eat the mollusk. They carried the shells for long distances and had to learn which were effective. The young appeared to learn the skill from older gulls. The skill involved judgements because the shell had to be dropped from just the right height and onto a relatively smooth rock surface so it would not bounce off into the ocean.

Another innovation in food sources was exhibited by great tits and chickadee-like birds in England in the 1930s. They found that they could obtain cream by pecking the aluminum foil covering milk bottles. This demonstrated their versatility in foraging.

Predator distraction is another area in which birds seem to show cognitive processes. In particular, the small plovers and sandpipers show complex behaviors seemingly employed to lead a predator away from the young. Long before the predator can see the nest or its eggs, the plover begins to call, then he may walk rapidly or fly in any direction away from the nest. Continuing to lead the predator away, the plover pipes loudly and if it is walking or running, the bird will use a crouch run with its head and body held lower than usual. The

bird might then hold its tail or wing in an abnormal position as it moves, often dragging it to suggest injury. After running, the bird might flop on the ground and extend one or both wings as if injured. This is called the 'broken-wing' display. Of course if the plover has no nest to protect, it will never approach an intruder or act conspicuous.

Learning to copy another animal's behavior signifies thinking about the task. Several studies showed examples of this in vocal song-learning in birds (Marler, Peters, Kroodsma, and Miller, cited in Griffin, 1984). Experimenters played tape recordings to young male birds who at maturity began to copy those songs. Parrots were believed to only mimic man's speech, but Pepperberg (1981,1983) trained an African Grey Parrot named Alex to name and ask for about 40 objects using english words. He could correctly name objects and actions (cited in Griffin, 1984).

Even the smallest insects have complex forms of communication. Holldobler and Wilson (cited in Griffin,1984) studied recruitment efforts of weaver ant workers to sisters to gather food or participate in other activities away from the nest. During recruitment, the ant faces another and they feel each other with their antennae (possibly transmitting the odor of food). Then the recruiter makes lateral head wagging motions. These messages induce followers. In the instance of

alarm, ants release alarm pheromones. If they need help, they lay an odor trail to the nest and recruit workers by jerking their bodies back and forth (rather than side to side as in food gathering).

Ants also exhibit communication chains. After receiving recruitment gestures, some workers turn to others and repeat the same gestures. This shows the property of displacement, because information is conveyed by a communicator who has not been directly exposed to it. Because the major part of communication is believed to be chemical in ants, we only see the surface of their abilities through gesture. But their social characteristics are intriguing, especially in view of Wilson's findings (cited in Griffin, 1984) that some ant species domesticate aphids. They build shelters for them and obtain food from them and protect them, living in symbiotic relations.

Perhaps, the most well-known of insects communicators is the honey bee. Karl von Frisch (cited in Griffin, 1984) first discovered the so called 'dance language' of the bees. Through this dance, new complex information is conveyed in a symbolic form. Before explaining the indications of the dance, one needs to be aware of the complex array of supplies needed to maintain temperature, larval cells, queens and inside workers in the hive, and the fact that these foraging bees are aware of which

commodities are in short supply and hunt for those. Many of the inside workers and the queen are sustained by trophallaxis which is the regurgitating of the stomach contents to feed another bee.

The waggle dance is only performed when the food source found by the older worker bees is in short supply in the colony. The worker moves rapidly across the honeycomb in a figure eight with several worker bees who press their heads and antennae against her body. The dance itself conveys information about the distance and direction of the food source. If it is within 30-50 meters of the hive, a round dance is used and beyond that a tail-wagging dance is employed. The vigor or amplitude of the abdominal motions indicates the desirability of the food.

Many other complex behaviors of the bees may well exist in their genetic make-up or nervous system as in swarming behaviors due to overcrowding. In 1955, Martin Lindauer (cited in Griffin, 1984) found that in conditions of overcrowding, workers begin to produce new queens by feeding different food to the larvae. Before the swarm leaves, the workers feed the queen less and force her to stop egg laying, so she'll be light enough to fly with them. She becomes more active and attempts to tear open the queen cells and kill the new queens but the swarm workers prevent her by pulling her away. Bees also are directed to their

own hive by its distinctive odor and can distinguish it from among hundreds of hives, even when it is moved.

Returning to mammals, dogs first used barking as an alarm signal. This was found by studying dogs reared in fields and wolves in dens (Murie, 1944, cited in Sebeok, 1968). Both barked when a stranger was sighted by them or approached. In studies testing puppies reactions to sounds, it was noted that they habituate to sounds much the same way human infants do. Dogs also learn to make different noises to obtain goals. In many ways, they seem cognitively closer to us than monkeys (which will be discussed next) because they do not have automatic responses to certain sounds, rather they respond in context to the general situation.

The bulk of information on communication among monkeys comes from early naturalistic studies. Struhsaker (1966) charted the vocalizations of vervet monkeys along with their probable messages (cited in Sebeok, 1968). More recent investigations note that American vervet monkeys recognize their companions as individuals and treat them accordingly (cited in Griffin, 1984). Signal patterns of rhesus monkeys were investigated by Rowell and Hinde, Altmann and Reynolds (cited in Griffin, 1984). The chart presented shows their collective results in terms of similarities. The ethological focus of these studies points more to the common

core of messages as a basis for more indepth investigations of their individual expressive abilities. Strangely, the gorilla, who seems to be our closest relative, is the least social of all apes. Fossy (cited in Smith, 1977) found a gorilla to make fewer than four vocalizations per hour in 2,255 hours.

Since humans needed to find out whether apes could communicate with humans, and chimpanzees are incapable of controlling their voice, many investigators have taught sign language to them. Although most of the subjects were chimpanzees, two gorillas (Patterson and Linden, 1981) and one orangutan (Miles, 1983) have been successful (cited in Griffin, 1984). Alan and Beatrice Gardner raised a chimpanzee named Washoe and taught her over 130 signs which she could use appropriately. She even combined signs to express unknown labels such as "water bird" for swan. Terrace (cited in Griffin, 1984) taught a male chimpanzee named Nim Chimpsky to use 125 signs but was disappointed that he showed no ability to combine more than two signs meaningfully. But does the ape's lack of human language fluency really undermine their cognitive functioning?

The size of the brain has been found to be an indicator of the levels of computational abilities, the larger brains having higher levels than small brains (cited in Lilly, 1978). This is significant in interpreting cognitive differences between apes, man and dolphins. The higher levels of

computation are due to the enlarged areas of the cortex where neocortexes include silent or associational brain areas.

Since dolphin brains are equal to or larger than the human brain, we must deduce that the larger brains are capable of extensions of computations into the past and future beyond the human range. Most cetaceans probably have a complex mental life. Dolphins also have the ability to match the sounds of human speech, unlike apes. The other function of a larger associational cortex is a larger memory space. Dolphins' capacity to integrate these memories is presumed to be equal to or greater than ours.

Whales and dolphins have existed on this planet much longer than man and have adapted to environmental changes. Some whale and dolphin brains became equal to the size of that of present day man and passed his current size thirty million years ago (Lilly, 1978). From Aristotle's writings, we find that dolphins existed in the Black Sea. He stated that "small boys and dolphins develop mutual passionate attachments" (Lilly, 1978, p.12) and wrote of dolphins giving them rides and pulling them through the water, and of one dolphin who beached itself and died of grief when a friendly boy left. Dolphins are extremely sensitive to touch. If you touch a dolphin, a bond of friendship begins. From about 400 BC to 1962 dolphin relations with man seemed consistent.

The compassionate nature of dolphins certainly suggests conscious thought and is reflected in the extraordinary efforts they employ to aid another animal. Even when the behavior is maladapted, they push their bodies below that of the ailing animal and lift it to the surface. They may then carry it on their backs even when misguided as in the case of a mother who carried a stillborn baby for days.

A special type of learning that dolphins exhibit is imitation. Dolphins have been known to imitate seals, turtles, skates and penquins. One even imitated the behavior of a diver who cleaned algae off the window including the sounds of his regulator. Karen Pryor (cited in Lilly, 1978) studied the ability of porpoises to adapt their behavior in a new stressful situation. They learned to change their normal behavior of blowing as they rise to the surface and just lie at the surface with only the blowhole above water so as to be less conspicuous to fishing vessels. Otherwise they swim rapidly to the right of the boat, having learned that the machinery with nets are mounted on the left.

Most cetacean experts agree that whales and dolphins have a knowledge of men and behavior ethics. In fact they are much more proficient at controlling their anger. In experiments, in spite of painful negative stimuli, they controlled their anger. This may be due to the huge cerbral cortex which could exert

direct inhibitory influences from higher level thinking processes on their expression of emotion.

In view of the impressive abilities of dolphins, humans could afford to give up their stand of cognitive supremacy and learn many lessons of environmental and interspecies respect from the dolphins. Please pay careful attention to the table contrasting the behavior of man and two kinds of dolphins (cited in Lilly, 1978). Certainly, most of the aforenamed communicating species exhibited numerous criteria of cognition in varying degrees: adaptability, displacement and long term memory. In the future, experiments might focus more closely on the cognitive aspects of animal communication. Hopefully if humans better understand other species, they would learn to live more symbiotically and refrain from killing for pleasure.

Carl Jung (1973) (cited in Griffin, 1984) reminds us not to get caught in our image of omniscience. In regards to the communication of bees he says " We are faced with the fact that the ganglionic system apparently achieves exactly the same result as the cerebral cortex. Nor is there any proof that bees are unconscious." In specific, I believe there is room for more research on the cognitive abilities of canines. Based on my own observations, they exhibit long term memory, the ability to plan and think, adaptability and imitative and

learning behaviors. Prospective experiments might center on a Piagetian type of approach, concentrating on adaptability to new situations, to determine the types of thinking different species might be employing.

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